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ABSTRACT

A program review was done of all aviation/aerospace-related higher education programs in Oklahoma. A team of nine experts reviewed statistics on the state's public and private programs, conducted a survey of institutions on industry status and projected training needs, and visited all 10 program locations. The project applied guidelines to evaluate the data and make recommendations. Evaluation covered the industry as a whole including aviation trends, manpower needs, merging technologies, and industrial workforce requirements; Oklahoma state programs; and private programs. The evaluation found that the State System is producing too many pilots and aviation maintenance technicians and devoting too little effort to planning designed to meet future aviation/aerospace needs in the state or nationally. The evaluation recommended a statewide comprehensive program planning process to improve efficiency and excellence and to develop strategies to meet current and future needs. New career track programs recommended include fiber optics, laser optics, robotics, and space medicine. In addition the State System was urged to identify strategies to encourage and facilitate participation of women and minorities in the industry. Finally, the report recommends that Oklahoma focus more resources on mathematics and science educational reform. Appendixes list task force members, describe the Task Force activities, and identify areas of future labor force shortages. (JB)

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ED 372 694

Systemwide Aviation/Aerospace Education Program Review

Aviation/Aerospace Task Force's Report to the Oklahoma State Regents for Higher Education

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SYSTEMWIDE AVIATION/AEROSPACE EDUCATION PROGRAM REVIEW

Aviation/Aerospace Task Force's Report
to the
Okahoma State Regents for Higher Education

January 1994

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AVIATION/AEROSPACE
SYSTEMWIDE PROGRAM REVIEW

Introduction

Systemwide program evaluation is viewed as one of several significant components in the State Regents' program for Academic Excellence and Efficiency. Specifically, Academic Excellence and Efficiency is designed, among other things, both to strengthen instructional program quality and delivery, and also to insure that academic offerings are meeting the educational needs of Oklahoma's citizens.

Several degree-granting programs offered by State System institutions were selected for purposes of conducting a systemwide program examination. Aviation/aerospace was one of those academic programs examined by a task force comprised of nationally recognized experts in the aviation/aerospace industry. The aviation/aerospace study is an attempt to provide important information that will be significant to the State Regents as they deliberate a course of action concerning existing aviation/aerospace programs offered by system institutions along with those that might come forward for purposes of program expansion and/or new program requests.

Task Force Charge

In August 1991, the State Regents authorized a systemwide external review of all State System aviation/aerospace-related programs. A team of nine internationally recognized experts was assembled and chaired by General James E. Hill. A list of the task force members is shown as Appendix A.

The Charge and an Amendment

The State Regents identified "aviation related programs" as a major target for review in its Systemwide Program Review. The task force was charged with the task of (1) evaluating current and projected industry need, (2) assessing the status of aviation programs in The Oklahoma State System of Higher Education, and (3) determining optimal delivery of services that are appropriate responsibilities of the State System and integrative with the vocational-technical education effort. (See Appendix B for complete text of the charge.)

The members of the task force amended the scope of the charge by adding the term "aerospace" to the title of the study. Thus, the study became the "Aviation/Aerospace Education Review," since Oklahoma's programs have the mission to train their graduates to meet the challenges of space as well as ongoing aviation needs.

The Collection and Compilation of Systemwide Data

One of the key data sources, created through the State Regents' Unitized Data System, was a review book which contained statistics concerning the state's public and private programs. Another important data source was a comprehensive survey instrument which was sent to a wide variety of aviation/aerospace-related institutions, seeking input about the status of the

industry and the projected needs of the industry in terms of training. The results of that questionnaire were boiled down and presented in a useful "trends" format which provided the task force with a ready picture of government/industry needs, projections, and future desires in terms of qualifications of graduates of state programs. The task force is most grateful for the assistance provided by State Regents' staff for making these documents possible.

In addition to the database gathered and compiled by the OSRHE Unitized Data System, other key research materials were provided by the Federal Aviation Administration; The University Aviation Association; the National Congress on Aviation and Space Education; and a special mention of materials provided by Frank Iacobucci, Spartan School of Aeronautics.

Program Site/Campus Visits

In addition to a variety of special meetings and sessions, task force committee members visited various locations for program evaluation including: The Hardesty Flight Center, Tulsa; Mike Monroney Aeronautical Center (FAA); Northeastern Oklahoma A&M College; Oklahoma City University; Rogers State College; Rose State College; Southeastern Oklahoma State University; Spartan School of Aeronautics; Tinker Air Force Base; Tulsa Vo-Tech; The University Center at Tulsa; and Western Oklahoma State College.

Methodology

The task force used the above guidelines as it visited and made evaluation of Oklahoma's aviation/aerospace programs. In all, 10 sites were visited by task force members. Task force members were well acquainted with the overall structure of the Oklahoma system before they made visits; members had met together in closed session before the visits in order to discuss general issues of aviation/aerospace education as well as the state of the industry. Program information supplied by the OSRHE Unitized Data System was helpful in preparing for visits. Other meetings with the Chancellor, OSRHE staff members, State Regents, and industry leaders were helpful in terms of gathering background information.

Each task force member brought a wealth of experience as well as day-to-day contact with aviation/aerospace issues to the task of visiting and evaluating programs. Members met to debrief after each visit. Soon thereafter they prepared notes. The study director also directed an extensive "grand debrief" after all visits were completed; under his direction, Ms. Lisa Iverson contacted each task force member for final comments, findings, and observations. Finally, Dr. Wallisch and Ms. Iverson drafted the first version of the report for yet another staffing by task force members, State Regents' staff, and significant other interested parties. State Regents' staff coordinated the report review process and double checked specific data where necessary.

Study Limitations

A single visit to any program can never provide enough information for any task force to truly know all there is to know (both good and bad) about something as complex as an aviation/aerospace program or a state system of programs. Even though the task force spent well over a year studying the System, getting to know its people, and traveling many miles around the state of Oklahoma...there is still so much yet to know. The OSRHE provided us

with almost more than we could digest; our hosts could not show us enough or help us enough to carry out our charge.

Since the task force completed their campus visits, the State Regents, at their October 1993 meeting, approved two Bachelor of Science in Aviation program options at Southeastern Oklahoma State University: Airways Science - Aircraft Systems Management and Scheduler/Dispatcher, and a Bachelor of Science in Airway Science at Langston University.

Study Contents

Part One of the report examines workforce demographics, aviation trends, technologies, future manpower needs/career opportunities, and aviation workforce requirements. This section of the report draws heavily, with permission, from the Federal Aviaion Administration's report entitled, "*FAA Aviation Forecasts, Fiscal Year 1993-2004*"; the 1992-92 Bureau of Labor Statistics' "*Occupational Outlook Handbook*"; Oklahoma State Occupational Information Coordinating Committee's "*Oklahoma Workforce 2000*"; Office of Aviation Policy, Plans, and Management Analysis, "*Quarterly Industry Overview, FY 1992*"; Aviation Information Resources, Inc., Atlanta, Georgia"; a 1989 report compiled by the Aerospace Industries of America, "*The Maintenance Job Report*," published by Future Professionals of America (FAPA), 1989; "*Pilot Employment Guide*," published in 1992 by Future Professionals of America; and "*Pilots and Aviation Maintenance Technicians for the Twenty-First Century: An Assessment of Availability and Quality*," a study completed by the August 1993 Pilot and Aviation Maintenance Technician Blue Ribbon Panel. In addition, comments are brought forward by the task force regarding educational issues/concerns as identified by the aviation/aerospace industry (both in Oklahoma and nationally) particularly as they relate to the quality of the graduates coming into the industry.

Part Two of the report examines existing aviation degree programs offered by institutions in the State System. Summary comments about the task force's findings are also included.

Part Three reviews other postsecondary entities offering programs and courses in aviation. In particular, the task force reviewed aviation programs offered by Spartan School of Aeronautics and identifies vocational-technical schools offering FAA approved curriculum in Aviation Maintenance Technology, Avionics, and General Airframe and Powerplant/Electrical programs (GAPE) in Oklahoma.

Based on the analysis of aviation trends, manpower needs, emerging technologies, and industrial workforce requirements, Part Four presents task force observations and recommendations designed to position the state to meet the demands of various segments of the aviation/aerospace community.

New Directions

When Chancellor Brisch introduced the task force members at the state capitol, he summed up the mission of the undertaking in this way:

> "*Just as a superb pilot always flies out in front of the nose of the aircraft, keeping ahead of the situation, so it is that this task force will check our course and give us a sense of*

where we should be headed. Every aviator knows the value of a sound flight plan. That's what our aviation education task force will do; they'll help us file our flight plan for the future!

The role of education in aviation is more critical now than ever before, especially in light of the amazing advances we have seen in airframes, aerospace vehicles, control systems, simulators, and satellites, to cite only a few examples. The technology employed in the air operations during Desert Storm made the entire world sit up and take notice. But every day that same technology speeds business people to their worldwide destinations and sends probes to the far reaches of the universe. In all of that, Oklahoma aviation/aerospace education has been there, supplying the people and the technology that get the job done.

And that's why we have put this task force together to make sure that Oklahoma's colleges, universities, and vocational-technical schools have the resources, talent, technology, and direction necessary to keep both Oklahoma and America at the forefront of aviation and space activity. 'Together, we will assess our programs and then file our flight plan for the future.'"

PART ONE

Aviation/Aerospace Industry Overview

A brief review of the aviation/aerospace literature suggests that the industry's future--both short and long term--will continue to fluctuate due to various economic conditions (labor force demographics, educational resources, environmental pressures, airspace congestion, and world politics). Moreover, the literature further indicates that the United States dominance within the aviation industry will diminish with increased global competition, especially from Asia, Western Europe, and the former Eastern Bloc countries.

Even with global competition, the United States aviation/aerospace industry is projected to grow as the gross national product continues to increase from $4.9 billion in 1992 to $6.6 billion in the year 2003. The world gross national product is projected to increase from $16 billion in 1992 to $22.9 billion in the year 2003. Gross domestic product is a significant indicator of business activity, which, in turn, drives the aviation industry. World aircraft fleets are expected to increase by 61% between years 1990 and 2005.

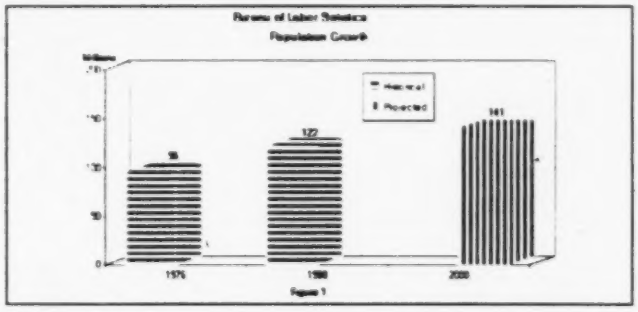
As new advancements in technology occur, the aviation work force will, among other things, be required to possess skills in working with computer based equipment and information systems. America and Oklahoma will also need engineers and technicians who have skills in more than one discipline and the ability to work together in cohesive groups to solve problems or refine technological advancement. Similarly, the work force will be required to work at a rapid pace, producing quality products at competitive rates. This type of work environment will require aviation employees to understand and utilize total quality management principles with a heavy emphasis placed on statistical process controls.

Moreover, technological improvements in advanced materials, avionics and electronic guidance will allow transportation vehicles to travel faster, carry more payload, and travel greater distances. The technological advancements will require the work force to have strong academic underpinnings in basic skills such as mathematics, science, and communication, in addition to having improvements in interdisciplinary knowledge and the applied sciences.

Aviation/Aerospace Demographics, Trends, and Technologies

United States Labor Force Demographics

Forecasts made by the United States Bureau of Labor Statistics show that population growth in the United States will continue through the year 2000 but at a slower rate. Growth between 1976 and 1988 was 27%; projections between 1988 and the year 2000 are forecast to increase by only 16% (Figure 1).



Compounding the reduction in growth rate is the 16 to 24 and the 25 to 34 year age groups are projected to show a decline in actual numbers by the year 2000. These age groups provide entry-level and low to middle level

engineering, technical and administrative personnel to the aviation/aerospace industry (Figure 2). Almost all the growth will occur among the 35 to 54 years of age group.

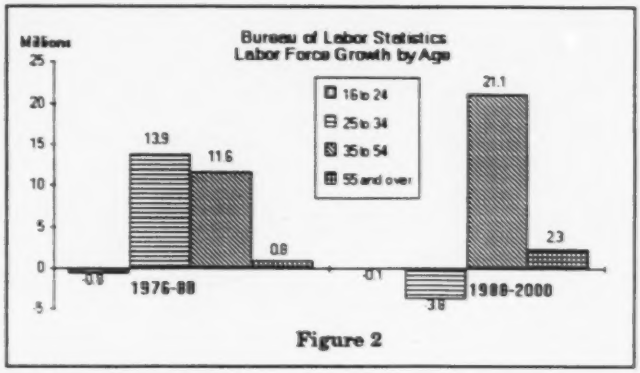


Figure 2

The labor force growth for women will be greater than for men. The larger labor force growth for women means that their proportionate share of the labor force will continue to increase (Figure 3). The Bureau of Labor data also suggests that the labor force is changing in terms of race and ethnic background. Over this period, African-Americans will continue to be the largest minority group. The Hispanics' share, however, will grow faster than the other groups due both to their higher birth rate and immigration.

Who will be entering the labor force by the year 2000? Of the 141 million persons in the labor force in the year 2000, 43 million will not have been there in 1988. Twenty-three million of the 43 million entrants (55%) will replace those leaving the labor force. The remaining 19 million represent net growth. Women will account for over 12 million (60%). Ten million of the new entrants will be from the minority groups.

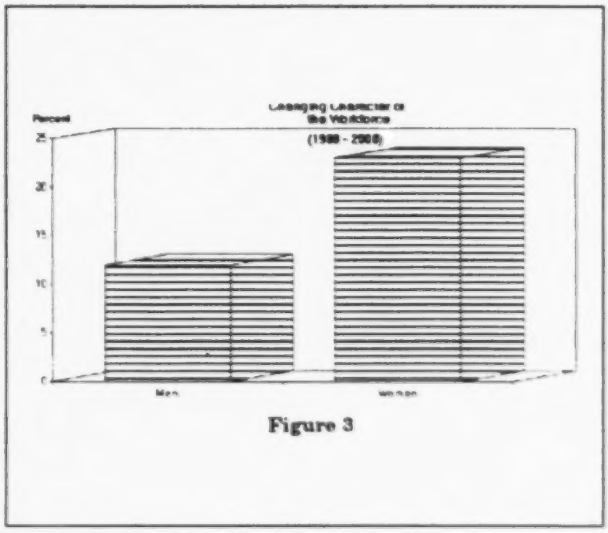


Figure 3

Industry Growth and Technology Trends

Since the end of the second World War, the aviation/aerospace industry has been a significant growth industry within the United States and the industrialized world. Fast and safe transportation of people, equipment, and products have become a required and an expected standard. Space travel has gone from a dream to reality, and the future expansion and exploration by transportation vehicles are only limited by mankind's ability to advance technology and to find the financial resources to make it happen.

In the future, as in the past, aviation/aerospace technology will be the launch industry for new advancements in high technology products. Within the next 20 years, terms like hypersonic, magnetic levitation, and electronic guidance will become common terms like supersonic, electro magnetic, and the micro chip are today.

The aviation/aerospace industry, however, is a very volatile industry dependent on domestic and international economic conditions. An example of the volatility can be seen by studying the trends of the commercial air transport sector of the aviation/aerospace industry. Since

the mid 1960s, the air transport industry has grown in spurts, with a cycling pattern which involves periods of decline, relative to the gross national product.

The Federal Aviation Administration (FAA) forecast of revenue passenger miles growth for the 1982 through 2003 forecast period indicates a significant increase in both the domestic and international markets. Domestic revenue passenger miles are projected to total 540.9 billion in the year 2003, an average annual growth rate of 4.1% over the 12-year forecast period. International growth is projected to more than double over that same 12-year period, reaching 255.8 billion in fiscal year 2003, an annual growth of 7%. From 1992 - 2003, the gross national product is forecast to escalate from $4.9 to $6.6 billion.

Aviation Information Resources, Inc., in Atlanta, Georgia, forecasts the world aircraft fleet to grow from 9,800 aircraft in 1990 to over 15,700 by 2005, a 61% increase. They also project the United States jet fleet to increase from 4,720 in 1990 to 6,519 in the year 2005, a 38% increase. Asia and the Pacific are forecast to be the fastest growing regions with 1,224 aircraft in 1990 expanding to 2,534 aircraft in 2005, a 108% growth rate. Europe, on the other hand, is expected to grow from 2,045 aircraft in 1990 to 3,977 by 2005, a 94% fleet growth.

Review of aviation/aerospace past employment trends from 1989 through 1992 suggests that when the economic conditions are down, massive reductions or downsizing occur as indicated in the data shown in Figure 4.

Forecasters have very little doubt that the world aviation/aerospace industry will grow at a robust rate over the next two decades, but there is a concern that the growth will not be conducted or orchestrated exclusively by United States companies or the national labor force within the United States.

The reason for this concern is that the aviation/aerospace industry is a front runner in the globalization of free enterprise. Strong competition has emerged from Europe, Asia, and former Eastern Bloc countries making inroads into the market.

Compounding the problem for the United States aviation/aerospace industry is the previously mentioned labor force demographic changes and the lack of faith in the American education system to properly prepare American youth for careers in high technology. While this concern will be addressed in another section of this report, a survey conducted by the Aerospace Industries Association of America in 1989 reveals that:

> *"...today, the industry recruits many highly-talented, well-prepared individuals. But increasingly, and unfortunately, aerospace firms also find that they must provide employees with remedial education. United States companies must be able to recruit employees who are strong in*

Compounding the problem for the United States aviation/aerospace industry is ...the lack of faith in the American education system to properly prepare American youth for careers in high technology.

fundamentals and who can easily adapt to new skills and processes."[1]

The Aerospace Education 2000 report notes

> *"The nation also needs workers with a 'world view.' Certainly, this is true for a global industry such as aerospace. The study of foreign language and cultures can only strengthen the flexibility and capability of our national workforce."*[2]

In addition to growth trends, there will also be technological trends which will alter the industry and the workforce. A number of technological changes are occurring now or are on the horizon. These technical changes include, but are not now limited to, such things as:

- Aircraft size will be expanding in the commercial sector. Boeing, Douglas and Airbus are studying an aircraft capable of carrying 650 or more passengers. If this becomes a reality, larger propulsion systems will also be developed, airports will require redesign, and ground transportation will become more of a major issue.

- If spacecrafts need to increase payloads, they will also require larger structures and propulsion units. Spacestations will become more of a reality by the year 2000-2010 with research and development expenditures starting to take place today.

- Another trend taking place is the rapid movement toward advanced avionics and electronic guidance systems. Aircraft, spacecraft and even automobiles are incorporating glass cockpit designs. New skills and philosophies will be required by the workforce to handle this new technology.

- Another technology emerging is the widespread use of new materials including metallic, composite, and ceramic materials. The need for materials that are stronger, lighter in weight and have a resistance to electrical impulses will increase as man attempts to travel faster, higher, and for extended periods of time.

- Another trend is the merging of specialties. We will see fewer engineers and technicians skilled in only one discipline. This will increase the need for interdisciplinary skills and the need for employees to be comfortable working with computer-based equipment and information systems.

- The aviation/aerospace industry is also moving toward a paperless system not only on the factory floor but also in the aircraft/spacecraft. Boeing is working on an Electronic Library System and an on-board maintenance system that display data on the instrument panel which allows monitoring and will allow functional testing.

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[1]*"Aerospace Education 2000, An Aerospace Industries Association Inventory of Education Concerns and Resources,"* Aerospace Industries Association of America, December, 1989, p.6.

[2]Ibid., p.6.

- Current propulsion systems are air breathing or chemically reacted. Research and development is working toward advancements in gravity avoidance and electrical impulse generation to propel future vehicles.

Lastly, high technology has only touched the tip of the iceberg; the future holds many secrets, and the aviation/aerospace industry will continue to be on the leading edge of technology advancement if the workforce can be properly prepared to keep up with the change.

Future Workforce Requirements

As the complexity of technology grows, the aerospace industry is convinced that not enough young people are preparing for jobs with a technology focus. While the need for workers with analytical, problem-solving, and conceptual skills is increasing, not enough bright, young Americans are choosing careers in science and technology. Demographics suggest the problem could become more critical; United States industry will need to rely heavily on recruiting among women and minorities who are not now choosing scientific and technological careers in great numbers. Compounding this scenario is a further concern that the United States student population, in general, does poorly in science and math relative to students in other countries.

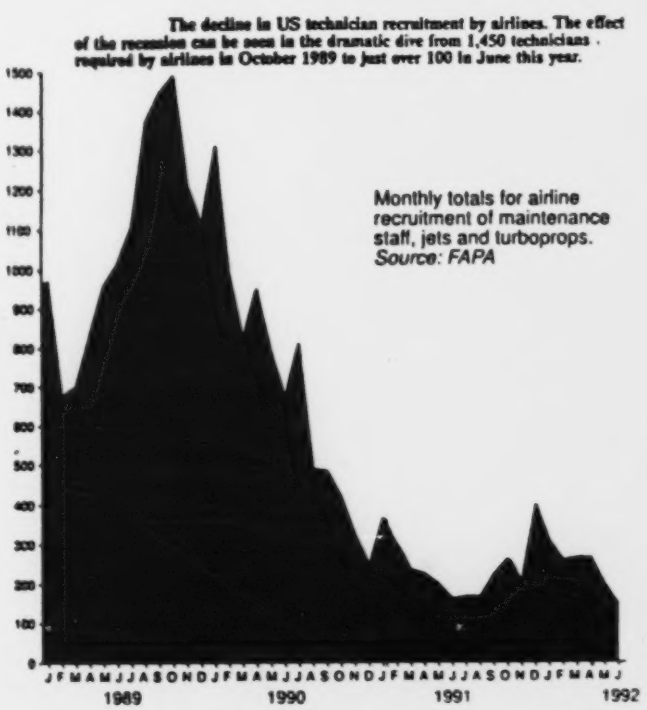
The decline in US technician recruitment by airlines. The effect of the recession can be seen in the dramatic dive from 1,450 technicians required by airlines in October 1989 to just over 100 in June this year.
Monthly totals for airline recruitment of maintenance staff, jets and turboprops.
Source: FAPA
1989
1990
1991
1992

Figure 4

Future workers will also be required to have a world view and understanding of the globalization of the industry. This implication requires knowledge of world geography and the reinforcement of foreign language skills in their educational programs.

Career Opportunities in the Aviation Industry

Since the aviation/aerospace industry is so diverse and widespread in high technology, the future manpower needs and career opportunities cover a very broad spectrum. Virtually every engineering/scientific and technician discipline is utilized by the industry. If a product is needed utilizing sophisticated materials in a close tolerance environment, the aviation/ aerospace industry will generally perform the research and development, develop the manufacturing processes, and refine the product for its full life cycle. These diverse products can operate on land, in the air or space, as well as on and under water.

Careers in aviation/aerospace involve both the civil and government sectors of the marketplace. Aviation/aerospace is a multi-billion dollar industry, approximately $140 billion according to the Aerospace Industries Association estimates, with profits estimated to be $2.6 billion in 1992. The industry employs between one million to one million four hundred thousand people. It is estimated there are about 595,000 production workers, 250,000 scientists and engineers, 310,000 technicians, and 200,000 various other employees in the industry.

In the state of Oklahoma, aviation/aerospace employment, measured by percent of total employment, shows the aviation/aerospace industry to be a major employer within the state. However, when compared with some other states, the total number of aviation/aerospace employees is small due to the low quantities of aviation/aerospace manufacturers and research and development activities.

In the state of Oklahoma, aviation/aerospace employment, measured by percent of total employment, shows the aviation/aerospace industry to be a major employer within the state. However, when compared with some other states, the total number of aviation/aerospace employees is small due to the low quantities of aviation/aerospace manufacturers and research and development activities.

The majority of Oklahoma's aviation/aerospace employment is generated by Tinker Air Force Base, American Airlines, Air National Guard Units, McDonnell-Douglas Aircraft, Gulfstream, FAA Aeronautical Center, Rockwell, Nordam, flight simulator companies, fixed base operators, repair stations, airports, and training institutions (approximate total workforce numbers 54,000). There are very few job shops that work on aviation related products which provide technical support to manufacturing, maintenance and research and development activities.

The task force notes that major aviation/aerospace employment in the United States is located in the states of California, Washington, and Texas, which all have large aerospace manufacturers, research and development activities. Job shop employment is also very high within these states. Job shop technical support can account for seventy-five to one hundred percent additional employment opportunities within the local areas of the original equipment manufacturers and research facilities.

Oklahoma is in a very precarious situation. If Tinker Air Force Base and American Airlines left the state, the aviation/aerospace market would be severely impacted. The lack of synergy within the Oklahoma aviation/aerospace community, the task force believes, is the major contributing factor affecting future expansion and prosperity of the aviation/aerospace industry within the state.

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Aviation Manpower Over Production

The task force believes air frame and powerplant mechanics and primary commercial pilots are two areas in the Oklahoma aviation/aerospace education system that produce an over-abundance of entry level employees for the industry. Both of these fields of study are producing excess capacity within the state, and most graduates need to seek employment elsewhere. The task force further believes the state would better serve its citizens by reducing the funds expended on airframe and powerplant mechanics and primary pilot education programs and increasing the funds to other fields of study, such as (see Appendix C for future shortages in aviation/aerospace specialty fields):

The task force believes air frame and powerplant mechanics and primary commercial pilots are two areas in the Oklahoma aviation/aerospace education system that produce an over-abundance of entry level employees for the industry.

Fiber Optic
Laser Optics
Industrial Engineering
Electrical Engineering
Civil Engineering
Astro Physics
Metrology (Standards)
Meteorology
Robotics
Aeronautical Engineering
Mechanical Engineering
Chemical Engineering
Petroleum Engineering

Workforce Skill Requirements

When reviewing a major technological industry such as aviation/aerospace, it is important to understand that the industry has three arms of activity: Research and Development, Production, and Product/Aftermarket Support. Within each arm, an organizational structure is generally developed to handle all activities for finance, technical operations, and marketing or sales. Therefore, employment opportunities within the industry are delineated within these three major areas; i.e., finance, technical operations, and marketing/sales.

The task force further believes the state would better serve its citizens by reducing the funds expended on airframe and powerplant mechanics and primary pilot education programs and increasing the funds to other fields of study...

The task force reviewed workforce skill requirements in technical operations only. No attempt will be made to define skill requirements in the finance or the marketing/sales sector of the industry. The aviation/aerospace technical operations sector of the industry is involved in the technological refinement and development of (1) structures, (2) propulsion, and (3) guidance. Structures consist of the craft or vehicle to be propelled; propulsion is the unit of

force used to accelerate or decelerate the structure; and guidance is the mechanism to read, record and store movement and direction of the structure and propulsion units.

Results of research and development within the aviation/aerospace industry has generated a key technological industry inclusive of the medical, automotive, communication, chemical, electronic, metallurgical and petroleum fields, to name just a few.

In the future, as in the past, aviation/aerospace technology will be the launch vehicle industry for new advancements in technological products. Since the aviation/aerospace industry leads the way for our technological society, it is important for education institutions to understand the variety of scientific and engineering disciplines and skills required by those who are seeking careers within the aviation/aerospace industry.

The need for interdisciplinary knowledge among the different fields of study and the uses of applied applications in the education process are required by both the technical and professional with degrees in engineering/science, and the technician who builds or maintains the product(s).

According to the Aerospace Industries Association:

> *"Aviation/Aerospace industry employs highly skilled workers, including nearly 20% of all American research and development scientists and engineers. However, aerospace productivity and quality improvement is not simply the province of scientists and engineers; it also depends upon the technical knowledge and expertise of thousands of technicians and skilled workers. These workers are experiencing rapid changes in production technology. Production jobs in aerospace increasingly require technical skills such as the ability to use computers to run sophisticated equipment, while technicians can be found performing tasks previously reserved for engineers."*

The report goes on to note that:

> *"Increasingly, and unfortunately, aerospace firms also find that they must provide some employees with remedial education. We need a workforce more strongly grounded in the fundamentals of science, mathematics, and reading and writing. In the year 2000, the strength of aerospace will depend as surely on its human resources as on its technology resources. As a nation, we must strengthen the industry/school/government partnership in order to better educate and train our citizens for a highly competitive world. We will be shortchanging all Americans unless we succeed."*[3]

In a highly technical field the tasks performed by the workforce in both engineering/scientific and technician sectors consist of the use of sophisticated equipment, materials, and processes which cost the companies millions of dollars to procure, operate, and maintain. Companies can no longer afford to have their equipment inactive due to computer downtime (often human error) or their material scrapped (often human error) or their in-process work backtracking from test failures during the process (often human error).

To avoid the above dilemma, the workforce must have a firm grasp of not only the basics of reading, writing and math, but also have a working knowledge of the industries' technical

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[3]Ibid., p. 6.

operations basics. The workforce must have skills in the applied sciences with a sound understanding of (1) materials composition; (2) the effects of temperature, speed, and pressures; and (3) tolerances due to variances in the environment during the building process and during product usage.

Aviation/Aerospace Industry: National Issues

Rapid advancements made in materials and processes and the technology to apply the application to form, fit, and function have changed dramatically over the past 40 years. This has caused the industry to create specialists for most functions performed in the work place. The specialists do not have a broad knowledge base of the applied sciences and, hence, are ill prepared in problem solving or enough flexibility to assist in areas outside of their specialty.

The complexities of a highly regulated, fast changing, high technology environment places an emphasis on productivity and quality. For the workforce to assist the companies, additional skills in team dynamics, technical processes, management, and total quality control concepts are required.

Industry can ill afford wasted time and effort. The industry is finding that employees with advanced degrees have to be retrained to perform to the industrial pace instead of the academic pace. Education institutions need to place less emphasis on theoretical models and give their students real-life projects that require hands-on involvement in group settings requiring multi-discipline knowledge.

The above mentioned concerns were expressed and highlighted in a report released by the Aerospace Industries Association entitled "*Aerospace Education 2000.*"[4] In summary, the report highlighted the following observations as they relate to the industry's concerns:

- Aerospace companies see a need for more interdisciplinary knowledge among scientists and engineers. Other areas which education must more closely address include manufacturing knowledge (especially important with today's emphasis on better linkages between design and manufacturing) and computer literacy.

- Companies believe more stress should be placed on communications skills - from verbal and written communications to team building - for their highest level of technical professionals.

- Educational needs include statistics (as applied to quality assurance and manufacturing process control), understanding of computer use and capabilities, and blueprint reading. Production workers may be deficient in basic math, reading comprehension, language, and communications skills. In the production workforce, companies are even encountering illiteracy.

- Computers are now so prevalent in aerospace manufacturing that computer "literacy" is becoming a fundamental requirement not only for technicians but also for production workers. A great deal of work - from database development to engineering

[4]Ibid., p. 9.

drawings to numerical control programming - is now done on computers. Five years from now, the factory worker will probably get all the required job information from a computer. Many experts feel that manufacturing technology is the real cutting edge of competition today; the availability of employees with the skills and flexibility to adapt to computers and other new equipment and production processes has become crucial.

Aviation/Aerospace Industry: Oklahoma Issues

When first assembled, the task force agreed that the study should also comment on the aviation/aerospace picture in Oklahoma, with particular emphasis on issues confronting the industry. The results from an industrial survey revealed the following insight into the effectiveness of both the industry and Oklahoma's educational programs meeting the needs of both public and private interests:

- Respondents were concerned that Oklahoma's programs be broad enough to prepare students for a changing marketplace, yet there was also concern for basic math, English, and "service skills." "Business skills," "people skills," and areas like history and geography were deemed important.

- Some respondents warned against the pilot-shortage trap, deeming other career areas to be more critical.

- Technical expertise was said to be important--yet "attitude" was a professional quality they valued as highly as technical skill.

- Concern was expressed regarding the interface between higher education and vo-tech. There was also a concern that Oklahoma's programs lacked unity, a sense of teamwork, and consolidated vision.

Part Two of this report examines existing aviation degree programs offered by institutions in The Oklahoma State System of Higher Education.

PART TWO

Program Review

In addition to evaluating current and projected aviation manpower needs, the task force was also assigned responsibility for: assessing aviation programs strengths/weaknesses; student graduates and placement success; program quality; facilities, resources, and program vitality/leadership.

State System
Aviation/Aerospace Programs

Ten colleges/universities offer aviation/aviation related programs and/or courses (matrix of programs is shown on the following page). Specifically, these institutions include:

Comprehensive Universities

- University of Oklahoma
- Oklahoma State University[1]
  - Oklahoma State University Technical Branch - Oklahoma City[2]
  - Oklahoma State University Technical Branch - Okmulgee

Regional Universities

- Southeastern Oklahoma State University[3]
- Langston University[4]

Two-Year Colleges

- Northeastern Oklahoma A&M College
- Rogers State College
- Tulsa Junior College
- Western Oklahoma State College
- Rose State College
- Redlands Community College[2]

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[1]Also takes aviation course work to the University Center at Tulsa and to Oklahoma Military Department in Oklahoma City.

[2]These institutions offer an A.S. or A.A.S. in Aviation, but the task force notes that these programs were inactive in spring 1991, and therefore a review was unnecessary.

[3]In October 1993, the State Regents approved two aviation program options: Aircraft Systems Management and Scheduler/Dispatcher.

[4]In October 1993, the State Regents approved a Bachelor of Science in Airway Science.

OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION

State Capitol Complex, Oklahoma City, Oklahoma

Aviation Degree Programs

1991-1992

OU	OSU	OSU-TB, OKC	OSU-TB, OKM	SEOSU	Langston	NEOAMC	Rogers	TJC	WOSC	Redlands	Rose
BS - Education Professional Studies	BS - Aviation Sciences			BS - Aviation (2 options - Airways Science - Aircraft Systems Mgmt & Scheduler/Dispatcher)	BS - Airway Sciences	AAS - Aviation	AS - Aviation	AAS - Aviation Sciences Tech.	AAS - Aviation	AAS - Aviation	AAS - Aviation
BS - Aerospace Engineering Studies	BS Aerospace Studies										
MS - Aerospace Engineering Studies	MS - Natural and Applied Sciences										
Ph.D. - Aerospace Engineering Studies											
Dr. Engr. - Aerospace											
		AAS - Avionics Electronics Tech.	AAS - Electronic Engineering Tech								
				BS - Airframe and Powerplant			AAS - Aviation Maintenace Mgmt.				
									AAS - Airport Mgmt.		

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Campus Visits/Special Meetings

Task force members visited a variety of locations and postsecondary institutions during their review. The team visited: the Hardesty Flight Center, Tulsa; Mike Monroney Aeronautics Center (FAA); University of Oklahoma; Northeastern Oklahoma A&M College; Oklahoma State University; OSU Technical Branch-Okmulgee; Rogers State College; Rose State College; Southeastern Oklahoma State University; Spartan School of Aeronautics; Tinker Air Force Base; Tulsa Vo-Tech; University Center at Tulsa; and Western Oklahoma State College.

Task force representatives conducted meetings, fact finding, and informational sessions with industrial leaders in the Oklahoma, Oklahoma City and Tulsa Chambers of Commerce, Metro-Tech Aviation Career Center, Tulsa Technology Center, and Oklahoma State University College of Osteopathic Medicine officials.

Findings

The task force recognizes that a single visit to each campus provided only a "snap shot" of the institution's program(s). The members did, however, review a significant quantity of data generated by the State Regents' data system, along with information provided by the institutions as they prepared for the team's visit. Additionally, the task force was familiar with Oklahoma's aviation history and felt well prepared to make its examination. To follow is a summary of the team's findings.

Status of Programs

The overall picture is that Oklahoma can be very proud of its aviation/aerospace related programs. The task force found some very solid programs, administered and taught by a cadre of highly skilled professionals who share a love for aviation and the new challenges presented by space exploration. The State System cares about students and wants to provide the best in teaching, research, and service. However, there is much work yet to be accomplished so the System can truly deliver programs that fully meet student needs, interface with worldwide industry requirements, and articulate with each other to create a "seamless garment" in terms of overall program integrity.

Begin with the two comprehensive universities and the Spartan School of Aeronautics to find the most extensive programs in Oklahoma. Include the Hardesty Flight Center in Tulsa, along with the opportunities available to students through The University of Tulsa and the Aviation Education Alliance. Students wishing to pursue a career in the aviation/aerospace professions will be well served by aggressively taking advantage of the instruction and facilities available in these programs. International programs at Oklahoma City University offer unique career possibilities. The program at Southeastern Oklahoma State University is also developing a fine reputation.

Other Oklahoma programs offer strengths as well but have limitations in terms of program range, facilities, and such resources as simulators or access to solid flight training. In brief, there are missing pieces in some programs, too narrow a focus in others, frequent duplication among many, walls of isolation between some, and uneven quality in such critical program elements as flight instruction.

Funding for programs is also a problem. Not enough support is going to programs, especially below the level of the comprehensives. To compound matters, programs themselves are not fully aware of all the avenues of outside support they can pursue by being more aggressive. The FAA, for example, can offer career help. Oklahoma schools for the most part seem unaware of programs like the FAA Airway Sciences Program. The University Aviation Association (UAA) can also be a strong support group. Moreover, industry and government partnerships become more and more important to the future of programs. We found room for improvement in the area often referred to as marketing and program development.

We were concerned about the interface between vocational-technical institutions and higher education programs. The vocational-technical institutions, in partnership with higher education, can help create that "seamless garment" we speak of often in this report.

Likewise, we think there must be more emphasis placed on teacher training for aviation/aerospace subjects. This goes hand-in-hand with the need to create a greater awareness in Oklahoma's K-12 system for careers in aviation. The program at the University of Oklahoma involving school children with simulated space missions is an outstanding example of the kind of aviation/space awareness activity that can be carried on with the K-12 group. Organizations like the FAA, UAA, and National Space Foundation can be of immense help in creating programs of this type.

The bottom line is that there is a range of program quality to be found in the System. There are great programs, but many need improvement in critical areas. Essentially, the System needs a strategic plan and a unifying force of some kind. A state commission, a central aviation/aerospace administrator, a broader alliance, or any mechanism to create unity, communication, articulation, and collaboration is badly needed. Otherwise, most programs will continue to go off on their own, create costly duplication, and miss the chance to tailor a "seamless garment" that could put Oklahoma in the forefront of aviation/aerospace education.

Evaluating Current and Projected Need

While there is a projected pilot shortage looming around the corner, Oklahoma's programs may well concentrate too much on only A&P and pilot training programs. Other needs of the industry may even be more critical and more promising in terms of significant career opportunities.

For example, the FAA has an ongoing need for some 15,000 technicians trained to maintain electronic systems. Yet it will tell you that one of its greatest difficulties is to find people who have the math and electronics background to work in today's sophisticated systems. There is also an ongoing need for air traffic controllers. The task force was pleased to hear that Oklahoma State University was interested in creating a training program for controllers, but schools in Minnesota, Pennsylvania, and California are already doing so with FAA sponsorship. That means guaranteed jobs for graduates. It also means meeting the needs of the industry -- everyone wins.

For every pilot, there are 500 people behind the scenes performing a wide variety of services. However, Oklahoma still concentrates a large portion of its program efforts on pilot and A&P graining. The task force was interested in finding more planning for programs that would train such support personnel as ticket agents, food caterers, and computer operators. Space

also offers a new career avenue, yet only one Oklahoma school appears to be seriously interested.

Planning for future programs is needed. Partnering with industry naturally helps schools understand and meet the needs of industry . . . and government. A central agency could conduct market research for all schools and help build program diversity throughout the System. Oklahoma State University and Spartan do a good job of researching industry trends -- everyone should. Technology advances, new systems come on line, and those who keep track can create programs that meet the needs of both the industry and the student.

University of Oklahoma

Overview. The University of Oklahoma offers the B.S., M.S., and Ph.D. degree in Aerospace and Mechanical Engineering Studies. The task force viewed these programs as essential to a comprehensive university and consequently focused its review primarily on the Aviation Track, Bachelor of Science in Professional Studies (College of Education), and other related aviation/aerospace activities.

With regard to undergraduate education, the task force notes that the university uses the liberal-professional model of education to provide undergraduates with the knowledge and skills needed to contribute and succeed in a rapid changing global marketplace. As a result, the institution offers undergraduate education in a wide array of majors it believes will meet the interest of students and the needs of Oklahomans.

The aviation education program is best characterized as a "special" program in the College of Education. A Bachelor of Science degree is awarded in Professional Studies (aviation track). Graduates are qualified as FAA certified flight or ground school instructors and pilots. In addition to the degree program, nine elective hours of aviation instruction and pilot training are combined with the FAA ground school to form a comprehensive pilot training program. This particular program was formally approved by the State Regents in 1979. The university owns and operates an airport and tower facilities at Max Westheimer field. After completion of the degree program, graduates are qualified as FAA certified flight or ground school instructors.

The task force learned that the College of Continuing Education is also involved in various other education and aerospace activities as well. These activities are primarily structured to deliver off-campus credit courses to Oklahoma educators. For example, the Aerospace Academy program is designed to teach student-centered instructional strategies and inquiry-based curriculum development with an aerospace emphasis. The Teachers Resource Center, also supported by the university, offers resource materials from the FAA, the National Academic and Atmospheric Administration, The Civil Air Patrol, and the National Aeronautics and Space Administration, to assist teachers in curriculum development. The Aviation Careers Education Academy, whose operation the task force was privileged to observe, introduces pre-high school and high school students to aviation and aerospace-related concepts. University programs that create and sustain the interest of pre-college students from kindergarten through twelfth grade in aviation and space programs represent a continuing commitment by the University of Oklahoma to play a major role in aviation education.

Productivity. The Aviation Track, Bachelor of Science in Professional Studies has conferred approximately 25 degrees over the past five years (1988-1992); headcount enrollment in this program over the same five year period averaged 57 students.

The university believes that its Aviation Education program is important to its undergraduate mission and indicates that its graduates are gainfully employed as entry level commercial pilots after they have gained sufficient flight hours, move on into military flight training programs, or are placed in an aviation related profession.

Program Quality. The quality of the flight training students receive is characterized by the task force as very good. The program has an outstanding safety record, and meets or exceeds requirements promulgated by the Federal Aviation Administration and other regulatory bodies to form a comprehensive pilot training program.

The task force notes however that a baccalaureate degree in pilot training is not a prerequisite for entry into the aviation profession. Typically, a non-military aviation career path requires an individual to obtain a commercial certificate either through a collegiate aviation program, a private flying school, or other fixed base operation. There are no minimum educational requirements for the commercial certificate, but the Federal Aviation Administration requires a minimum of 250 hours of flight time and a proficiency examination. Traditionally, air carriers have required additional experience before a candidate would be hired, but the amount of "additional" experience has depended, in large measure, on the existing supply and demand.

Facilities/Equipment. As previously mentioned, the university owns and operates an airport and tower facilities at Max Westheimer field. The airport houses 11 aircraft with an estimated value in excess of $275,000. The University provides aviation instruction with the help of a program director, program development specialist, chief flight instructor, nine flight instructors, and three aircraft maintenance personnel (two full-time and one part-time). Instructors are well qualified and a highly competent group.

A most important element in pilot training, the task force believes, is the availability of training aircraft (and simulators) for instructional purposes. However, aviation industry leaders indicate that rapid increasing cost of general aviation and training operations, resulting from current product liability legal actions, have led to severely decreased U.S. production of general aviation aircraft and an increasing dependency on foreign-made aircraft.

According to the Federal Aviation Administration, 16,336 aircraft were used primarily for instructional purposes in 1991. Although no estimates are available to predict the effect of advancing age of the training fleet, the number of years for which training airplanes can be economically and safely maintained is limited. The task force is unsure of the age of the aircraft currently in the fleet owned by the university as well as the university's aircraft maintenance costs. The university, therefore, (as well as other institutions offering flight training) must be mindful that as aircraft age increases, maintenance and other related cost to keep them air worthy and safe to operate will also increase. As well, product liability is viewed as a major factor in keeping training aircraft production low and prices high. The cost of a new, equipped basic training airplane generally exceeds $100,000, due, in part, to the high insurance and legal fees incurred by flight aircraft manufacturers.

The task force recognizes that OU has linked itself with business, industry, and government. A partnership approach among all academic entities for sharing resources and to avoid duplication and competition between programs would be of value to the university. Further articulation agreements between four-year universities, two-year colleges, and vocational-technical schools would give the state of Oklahoma a total aviation system to market. Other states are already using this model. The campus, classrooms, teaching equipment, flight line, the university's Aerospace Academy, and other areas visited by the task force appear to provide an excellent learning environment.

Need. With the downturn in aviation, both in the military and the industrial sectors, the task force believes it is appropriate that the university examine the Aviation Education (in Professional Studies) degree for purposes of determining, among other things: whether or not the program remains central to the institution's mission; whether or not the program is located in the appropriate College; whether or not the costs associated with operating the pilot training facility justify its continuation; and, whether or not exploratory discussions with other institutions in the State System for purposes of offering joint programs in aviation might be warranted.

Oklahoma State University

Overview. OSU offers the bachelor's degree in Aviation Sciences with four options: Professional Pilot, Aviation Management, Airway Computer Science, and Technical Services Management. The program was approved by the State Regents in 1989 and, like the University of Oklahoma, its aviation program is housed in the College of Education. Aviation Science courses are also available through the University Center at Tulsa. Both flight training and ground school courses are conducted under Federal Air Regulations (Part 144).

Unlike OU, the flight training component of the program is performed by flight training contractors. Thus, the degree program is a fusion of liberal arts, management, business, and flight training courses. The task force, however, raises the question as to whether the College of Education is the appropriate location to house the Aviation Sciences degree program.

Productivity. Over the past four years (1989-1992) the university has conferred approximately 62 Bachelor of Science degrees in aviation sciences. Headcount enrollment over the same period of time consists of 199 students, most of whom have enrolled in the program over the past three years. Graduates found employment as flight instructors at fixed base operators, military pilots, commercial pilots, and aviation related occupations. The university indicates that 83% of its graduates in 1991 found employment.

Quality. The task force wishes to use this section of the report to mention the Aviation Education Alliance concept unfolding in Tulsa, Oklahoma. Capitalizing on a large endowment from Roger and Ann Hardesty, the OSU Aviation Sciences program at the University Center at Tulsa is viewed as having the potential to produce a skilled aviation work force for Tulsa and the Southwest Region of the United States. Linking OSU and UCT with other aviation providers (OSU Technical Branch - Okmulgee, Tulsa Junior College, Rogers State College, Tulsa Area Vo-Tech), business and government, the Alliance is designed to train students in such career areas as: aircraft maintenance, maintenance management, flight services, administration, operations, information management, electronics, professional pilot, aviation management, avionics, and computer science.

The partnership developing between the OSU College of Osteopathic Medicine and the OSU/Tulsa Alliance has merit. The task force believes the altitude chamber acquired by the College of Osteopathic Medicine signals opportunities to consider new career tracks, such as astronaut/flight surgeon, as a way to anticipate/explore the new age unfolding in extended space exploration.

The task force believes the Alliance serves as a consortium model to be explored and potentially duplicated in other parts of the state as a way of reducing costs and still meeting industrial needs.

Facilities/Equipment. Oklahoma State University has contracted its pilot training component to a fixed base operator, thereby avoiding the burden of aircraft maintenance costs. While flight simulators are adequate, the university will need to develop a replacement plan to ensure state-of-the-art equipment and related facilities are in place to keep pace with the industry.

Need. Considering the university's long history in aviation education and its association with NASA, the number of program graduates continues to be modest. An examination by the university appears to be in order regarding whether or not the Aviation Sciences program remains central to the institution's mission, is housed in the appropriate college, and whether or not there are sufficient fiscal resources to invest in the program.

Southeastern Oklahoma State University

Overview. As a regional state university serving the educational needs of southeast Oklahoma, the institution has selected programs of instruction in the liberal arts and sciences, business, teacher education and technology leading to the baccalaureate degree. Through the College of Business, the university offers a Bachelor of Science degree in both aviation and airframe/power plant. These several aviation programs, the task force believes, are designed to meet the aviation needs in the southeast region of Oklahoma.

B.S. Aviation - has graduated approximately 80 students over the past five years (1988-1992). Fall headcount enrollments over the same period of time indicate approximately 411 students enrolled in the Bachelor of Science - Aviation.

B.S. Airframe and Powerplant - has graduated 26 students over the past five years; fall headcount enrollments over the same period of time indicate a total of 60 students have enrolled. Both programs have shown increased student interest over the past several years.

Quality. The task force believes that the quality of the aviation programs are well-suited to meet regional needs. Both programs are certified by the Federal Aviation Administration (FAA) and both programs are respected by peer institutions as well as the industry they serve. Program quality is also demonstrated by graduate placement. Students appear to possess the necessary training to perform at industry entry-level standards. Flight instructors are well qualified to provide the level of training required by the program.

Facilities/Equipment. The task force notes that airport facilities owned by the university are adequate but need some improvements. The hangers, maintenance facilities, and flyer operations are extremely clean and orderly. The university owns a fleet of 14 aircraft which are washed and waxed frequently, resulting in a fleet of snappy looking airplanes.

The task force also notes that the university has a limited number of twin-engine aircraft and, like most other aviation programs in the State System, lacks modern, high tech simulators. Improved facilities, aircraft replacement, and the modernization of simulators must all become a high priority if the institution wishes to continue to attract airline pilot hopefuls. While the university possesses a group of talented flight and airframe/powerplant instructors, opportunities for continued staff development must be assured as a result of the rapid changes occurring in the aviation industry.

Productivity. University officials indicate, at the time of the team's visit, that program graduates were entering many segments of the industry. Some were flying or performing maintenance for large and small commercial airlines. Some had entered the military sector (U.S. Air Force, U.S. Navy, U.S. Marine Corps, U.S. Army, as well as the Reserve and National Guards). Still others obtained employment as flight instructors, on demand charter pilots, and maintenance personnel for flight schools and fix-based operators. Many Airframe and Powerplant Management graduates had entered the industry as factory representatives at such companies like McDonnell-Douglas, Lear, Cessna, and Beechcraft.

Need. The task force suggests, as the aviation industry, particularly manufacturing plants, begin to reduce their work force in response to economic trends, that the university should conduct an industry needs analysis to determine the extent to which the institution may or may not be producing too many airframe and power plant graduates. A similar analysis would be equally appropriate with regard to aviation (flight) programs.

Northeastern Oklahoma A&M College

Overview. Northeastern Oklahoma A&M offers an Associate in Applied Science degree in Aviation that essentially operates under the minimum regulations of the Federal Aviation Administration as a Federal Air Regulations (FAR) Part 141 approved school.

Facilities/Productivity/Need. The college does not own or operate training aircraft; flight training is available to students at the local airport in Miami, Oklahoma. The college does, however, possess a flight simulator that needs to be replaced with a more current model. The program is small and produces a low number of trained pilots. There is concern by the task force as to: (1) whether or not the college (or its flight training provider) can invest sufficient resources in equipment, flight training equipment, and state-of-the-art simulators to keep pace with technological changes unfolding in the industry; (2) whether or not there is sufficient student demand (five graduates over the past five years, headcount enrollment over same period of time average five students per year) to warrant continuation of the program; and (3) with the availability of flight training and aviation technical career choices through the Aviation Education Alliance unfolding in Tulsa, whether or not the program is unnecessarily duplicative of those at other institutions.

Rogers State College

Overview. Located in Claremore, Oklahoma, the college offers an Associate in Science degree with an emphasis in Aviation and an Associate in Applied Science in Aircraft Maintenance Management. The latter degree is designed to prepare graduates for immediate entry into the aviation maintenance industry. During its campus visit, the task force was

informed by college representatives that the institution had sought authorization from the State Regents to offer options in aircraft powerplant technology and aircraft structures technology; however, that approval was not granted. Rogers State College is also a member of the Aviation Education Alliance.

Facilities/Productivity/Need. As the task force has already presented, demand for pilots and aviation maintenance technicians is closely linked to the nation's economy. Rapid expansion by air carriers and their supporting repair stations in the late 1980s created a momentary high demand for both pilots and aviation maintenance technicians. The current economic recession has generated a greatly reduced demand for these several professions in the job market.

Rogers State College's reports of degrees conferred and headcount enrollments in both pilot training and aviation maintenance production, over the past several years, in the opinion of the task force, reflect market trends. Both programs show little growth and clearly appear to be on the decline both in terms of graduates produced and headcount enrollment over the past five years.

Until demand in the market place for both pilot training and/or maintenance technicians improve, the task force suggests that the college review its role as a pilot and aviation maintenance provider. Particularly, this review should be conducted by including aviation employers in the Tulsa area (Rockwell International, American, Delta Airlines, etc.) to assist in this analysis and in the context of other nearby programs.

Western Oklahoma State College

Overview. Located in the same community as Altus Air Force Base, the college, through its Technical Education Division, offers an Associate in Applied Science in Aviation and Airport Management. Meeting minimum Federal Aviation Administration (FAA) requirements, the aviation component of the college's program, and in particular the Air Club, has served as a mechanism to introduce and sustain community and student interest in flight training.

Facilities/Productivity/Need. The aviation program has produced between 15 and 17 trained pilots over the past five years, and the Airport Management program has been less productive, only six graduates have completed the program over the same period of time.

While the program director indicates both programs are serving a need in southwestern Oklahoma, the major value of the aviation program, in particular, to the college appears to be the ability to provide opportunities for students who wish to participate in flight training for recreational purposes or to participate in intercollegiate flight competition.

Aviation facilities, including aircraft and flight briefing room, are leased from Altus Municipal Airport. The college makes available classroom space and flight simulators. Though airport facilities are modest, the job seems to get done. However, the programs could benefit from improvements in hanger and maintenance space. Twin-engine aircraft would also provide much needed multi-engine flight time. The aviation program could also benefit from the

inclusion of high-tech courses designed to match future industrial needs and from technically advanced simulators.

With a downturn in the need for college trained pilots, the absence of advanced training equipment, a need for twin-engine aircraft and maintenance space, the task force suggests that the college carefully review its aviation program. In particular, the task force believes that with student interest in aviation primarily for recreational purposes or to compete in collegiate competition, the aviation courses might be offered for non-credit elective credit. Efforts also should be made to make the program as self-supporting as possible.

Rose State College

Overview. The Associate in Applied Science program description for the Aviation, Professional Pilot option indicates that the program is designed to prepare students for a career as a professional pilot. College officials indicate that, because of limited opportunities in the industry, most Rose State students take aviation courses either to satisfy FAA requirements for private pilots licenses or to prepare them to take the certification examination; others have prior pilot training and are seeking flight training to upgrade their skills.

Facilities/Productivity/Need. The college's primary investment in the aviation program is in the form of faculty and aviation simulation technology. Students must work out flight training with local fixed-based operators on their own; and for some, this responsibility appears to be a difficult task. However, students continue to express interest in the program. Headcount enrollments over the past five years demonstrate that interest. Approximately 200 students per year are enrolled in the aviation professional pilot option. The record of graduates from the program over the same period (1988-92) indicates 57 students have completed their degrees. The task force proposes that Rose State College consider making its professional pilot program (1) a continuing education offering and/or (2) investigate collaborative arrangements with the University of Oklahoma, particularly for flight training opportunities for its students.

Oklahoma State University Technical Branch - Okmulgee

Overview. OSU Technical Branch - Okmulgee might be best characterized as a unique technical branch in the state's higher education system--unique because the primary mission of OSU Technical Branch - Okmulgee is to focus only on the teaching of advancing technology courses and program. The majority of the institution's instructional programs requires 90 semester hours for the Associate in Applied Science degree as opposed to the traditional 60 to 65 credit-hour programs offered by other two-year schools in Oklahoma.

Members of the task force reviewed the Associate in Applied Science degree program in Electronic Engineering Technology-Avionics option in the Electrical/Electronics Technology Department. The task force views the core curriculum in this program as very strong, particularly for technical skills required for avionic technician jobs and other related positions at the entry level. Laboratory equipment for electronics is high quality with several practical hands-on training devices available for student use. The avionics option is also a part of the Tulsa Aviation Education Alliance.

Facilities/Productivity/Need. The Electronic Engineering Technology degree program is linked to the institution's advancing technology mission and has, over the past five years (1988-92), demonstrated strong enrollments and a high program completion rate (283 degrees conferred over five years).

Graduates from the avionics option (16 since the summer of 1992 - first graduates from this program option did not occur until the summer of 1992) are finding employment with companies using two-way communication systems (e.g. utilities companies, cellular telephone industry, and paging systems), and consequently the task force believes that the two-way communications industry will continue to grow and graduates from OSU Technical Branch - Okmulgee's Electronic Engineering Technology (Avionics option) will continue to be in demand.

The task force members were most impressed with the institution's graduate performance guarantee to the student's first employer that he/she possesses the necessary academic and technical competencies required for entry level occupations.

Tulsa Junior College

Overview. Also a member of the Tulsa Aviation Education Alliance, Tulsa Junior College offers an Associate in Applied Science degree in Aviation Sciences Technology with options in Aviation Maintenance, Avionics, Management, and Professional Pilot. The objectives for these program options are to prepare students with the necessary skills to enable them to become certified as FAA airframe and powerplant technicians, certified with Federal Communication Commission, certified as an avionics technician, to take on a managerial role in the aviation industry, or to acquire FAA private pilot and commercial pilot certification.

Facilities/Productivity/Need. Task force members learned that TJC was only recently given authorization (1991) to confer a degree in aviation sciences technology and observed that enrollments for 1991 and 1992 were 190 and 250, respectively. Because of the short time spent on TJC's campus, the task force did not have the opportunity to tour facilities or determine the college's investment in equipment. TJC officials indicate that many students in the program were already gainfully employed and were returning to college for the purpose of gaining a degree in aviation science technology. TJC officials also noted that graduates from their program who were not already employed were finding employment with small regional air-carriers which required them to leave the Tulsa area.

Since the program is relatively new, with the Tulsa aviation industrial community currently "right sizing", in particular McDonnell-Douglas, the task force recommends that the college, in coordination and collaboration with representatives from the aviation industry in Tulsa, examine the merits of (1) continuing the program (and its various options), (2) capping enrollments to ensure there is not an over-production of aviation graduates, or (3) shifting responsibility for producing aviation maintenance and avionics to the Tulsa Technology Center.

Summary

As a consequence of its examination of aerospace/aviation education programs in Oklahoma, the task force wishes to make the following summary comments. (Recommendations for aerospace/aviation education program improvements will be presented in Part Four of this report.) First, the task force acknowledges the rightful role of community colleges in Oklahoma to provide training opportunities for immediate job entry or for transfer to an upper division baccalaureate degree granting institution. Clearly, two-year colleges play a central role in providing instructional programs designed to meet both community and industrial needs, particularly when those needs are identified/justified by community advisory panels or by state and/or industrial leaders. Likewise, community colleges must be willing, and encouraged, to down-size or eliminate those programs of study that no longer serve a community or industrial need. Savings from program deletion or program downsizing should be reinvested to strengthen existing programs or to explore an unmet need central to the college's mission.

The task force urges the comprehensive universities and the four-year institution offering aviation/aerospace programs of study also to examine their undergraduate (and graduate) programs for purposes of determining the extent to which these programs continue to be central to the institution's mission, continue to meet a societal need, and can be financed in such a way as to ensure program quality.

As a final point, the task force believes that the proportion of students actually graduating from pilot training or airframe/power plant programs is small in light of the headcount enrollments. These programs should be thoroughly examined to determine the extent to which such programs are serving the needs of degree seeking students versus the avocational/continuing educational need in their various communities. If indeed the latter instance proves to be the case, it is recommended that those programs be offered for non-credit at full cost.

PART THREE

Other Providers of Aviation Education in Oklahoma

In addition to several Oklahoma institutions of higher education offering instructional programs in aviation/aerospace education, there are other "players" involved in this instructional endeavor as well; most notably, Spartan School of Aeronautics and Oklahoma's Vocational-Technical system. Task force members had the opportunity to meet with Spartan officials and tour the facilities. To follow is a summary of the team's observations.

Spartan School of Aeronautics

Spartan is a proprietary, two-year school located in Tulsa, Oklahoma. The institution offers: certificate, diploma, and Associate in Applied Science degrees in aviation/aerospace related programs to domestic and international students. The school has, over the course of its existence, enjoyed a worldwide reputation for its ability to prepare graduates with the required technical skills for immediate job entry in the aviation industry. Specifically, Spartan offers Associate in Applied Science degrees in the following technical fields of study: aviation maintenance technician, aviation maintenance technician (with helicopter specialty), airframe and aviation electronics, aviation instruments, communication technology, aviation electronics. Students may also receive an associate degree as quality control technicians. The school offers a comprehensive flight training program along with its technical component. The institution owns 69 twin and single engine aircraft. Training simulators are state-of-the art and the instructional faculty are clearly first rate, capable, and extremely competent individuals.

Approximately 620 students are enrolled in the flight training program component and approximately 850 students are enrolled in various degree granting, technical/maintenance fields of study. Spartan officials indicate that enrollment has declined over the past three years: from 2,291 students in 1990, to 1,764 in 1991 and 1,301 students in 1992. There has also been a corresponding decrease in the number of degrees awarded, in spite of the school's including a new Associate in Applied Science in Aviation/Flight. There were 360 degrees awarded in 1991 and 313 in 1992.

The school acknowledges that, with the downturn in the aviation/aerospace-related industry, they have had to work extremely hard to place graduates. While the school places over 80% of its graduates, Spartan officials indicate they may cap enrollment to ensure those students coming through their programs have a fair chance to become gainfully employed after graduation. Because of the downturn in the aviation industry among other considerations, the school's leadership is evaluating whether or not the institution should expand/modify its mission to include health related career programs. Spartan officials also worry that State System institutions may be training too many pilots and too many A&P mechanics.

Spartan officials also worry that State System institutions may be training too many pilots and too many A&P mechanics.

Aviation Maintenance Technology, Avionics, and GAPE Programs in Oklahoma's Area Vocational-Technical Schools

The remaining "player" in aviation related preparatory programs is the state's Vo-Tech system. Task force members did not have the opportunity to visit each Vo-Tech campus in Oklahoma, but several team members did visit the Tulsa Vo-Tech campus and Metro-Tech Aviation Career Center in Oklahoma City.

From the visit to the Tulsa Vo-Tech Center, team members learned of a joint effort of the Tulsa Technology Center, Tulsa Junior College and Oklahoma State University, called a 2+2+2 program in Aviation Maintenance Technology. The program is designed to prepare students as aviation maintenance technicians, beginning in high school and terminating with an Associate in Applied Science degree in the maintenance technology field. As well, graduates are able to continue their education toward a bachelor's degree at Oklahoma State University.

Listed on the following page are the area Vocational-Technical schools which offer FAA approved curriculum in Aviation Maintenance Technology, Avionics, and General Airframe and Powerplant and Electrical Programs (GAPE) in Oklahoma.

Given the downturn in the aviation/aerospace industry; advancing trends in technology; the range of quality found by the task force in the two-year college sector; and the need to reduce duplication and better focus resources, the task force believes there exists a climate for greater collaboration and coordination between two-year colleges and the Vocational-Technical system. The task force recommends that the Chancellor of the state's higher education system enter into dialogue with the Director of the state's Vocational-Technical system for purposes of (1) determining how the two systems might work together to address the long and short term needs of the aviation/aerospace industry as well as (2) how they might collectively serve the needs of Oklahomans interested in quality aviation/aerospace programs.

Aviation Maintenance Technology, Avionics, and GAPE Programs in Oklahoma Area Vocational-Technical Schools

Area Vocational-Technical School	Curriculum	Certification Rating
Canadian Valley AVTS	General Airframe	Airframe
Gordon Cooper AVTS	General Airframe	Airframe
Indian Capital AVTS - Muskogee	GAPE General	*
Metro AVTS - Aviation Career Center	General Airframe Powerplant Avionics	Airframe and Powerplant
Metro AVTS - Foster Estes	GAPE General	*
O. T. Autry AVTS	General Airframe Powerplant	Airframe and Powerplant
Tulsa County AVTS Airpark Center	GAPE Airframe Powerplant Avionics	Airframe and Powerplant Avionics Technology
Mid-America AVTS	GAPE General	*
Northeast Oklahoma AVTS - Pryor	GAPE General	*

* Certification rating in conjunction with another AVTS

PART FOUR

Summary

Based on the analysis of aviation trends, manpower needs, emerging technologies and industrial workforce requirements, along with our review of Oklahoma's aviation/aerospace programs, the task force submits recommendations to position the State of Oklahoma to meet the demands of various segments of the aviation/aerospace community.

The aviation/aerospace industry, as revealed in Part One of the report, is a diverse and dynamic industry profoundly impacted and driven by the economy and market force demands. Over the past six decades for example, its labor demands have continually shifted from critical shortage to excess supply. Increasing international competition, technological advances, and labor force trends have also affected the industry in way that would have been viewed as improbable twenty years ago. New skills, new talents, and new philosophies will be required of those wishing to enter the aviation/aerospace workforce with the approach of the twenty-first century.

Recommendations

The task force believes that institutions in the State System are producing too many pilots and aviation maintenance technicians and engaging in insufficient planning designed to meet future aviation/aerospace needs in Oklahoma or nationally.

The task force proposes the following:

A. A state-wide, comprehensive program planning process designed to improve efficiency and excellence as well as to focus on strategies whereby the State System can collectively meet the current and future aviation/aerospace manpower needs, is crucial. In this regard, new career track programs (fiber optics/laser optics, robotics, space medicine/surgery, etc.) should be researched with an eye toward anticipating further aerospace shortages.

The State System must address the issues of the volatility of the industry, global competition, changing technology along with other diverse aviation/aerospace manpower skills needed for the future, and do so within a cooperative context involving all pilot/maintenance education providers if indeed Oklahoma is to become an aviation/aerospace education leader.

A year-long comprehensive program planning process, led by the State Regents, should address: (1) the development of a strategy to eliminate (or reduce) aviation/aerospace programs not justified by employment opportunities, programs of low productivity, programs not central to an institution's mission or programs that are not cost effective; (2) a determination of the extent to which regional collaboration/coordination (or merging) of specific aviation/aerospace programs of study in the State System might be accomplished; (3) an examination, in cooperation with the vocational-technical system, as to how the two-year college system might better work together to meet, in particular, pilot training and aviation maintenance needs in the State of Oklahoma and regionally; (4) an examination as to how a stronger

partnership/linkage among the Oklahoma higher education community, industry, and the federal/state governments might unfold for purposes of: (a) determining how the State System might better position itself to meet the advanced professional/technical skills students will be required to have to enter the industry; (b) determining future technological trends and their impact on faculty, instructional programs, and institutional resources to meet those needs; (c) determining industry contributions to reduce the expense of training current and future aviation/aerospace personnel; and (5) identify pilot training programs that are essentially serving the avocation/continuing educational needs those programs that should be offered for non-credit at full cost.

B. The task force further recommends, because of the underrepresentation of women and minorities in industry employment, that the State System identify strategies designed to encourage and facilitate participation of these several groups in the aviation/aerospace arena.

The task force believes the earlier in life boys and girl in general, and minority students in particular, are introduced to the exciting career opportunities aviation/aerospace can offer, the more likely they are to view this profession as a serious alternative. Partnerships between higher education and common education, which focus particularly on introducing elementary and secondary school students in general and minority students in particular to aviation/aerospace related opportunities may prove profitable and most beneficial.

C. The task force further recommends that because of the basic nature of the core curriculum in mathematics and science to all advanced curriculum and the aviation aerospace arena that Oklahoma focus more of its resources on the important area of mathematics and science reform as reflected in the *America 2000 Goals* and the *Goals 2000 Plan*.

As the task force has stated numerous times in Part One, the new advancements in the aviation technology and workforce will require strong underlying basic skills firmly rooted in the disciplines of mathematics and science. Without this firm foundation, it would be impossible for students to make the transition into the myriad possibilities available in the aviation space industry.

In closing, the task force is most pleased to have had the opportunity to review and evaluate Oklahoma's aviation/aerospace programs. We firmly believe, from our examination, the most significant initiative that Oklahoma must undertake is to establish a platform from which the State System can take advantage of current and future aviation/aerospace opportunities. That can only be done, in the opinion of the task force, by the State Regents leading a comprehensive planning process designed to move Oklahoma's aviation/aerospace programs into the twenty-first century.

APPENDICES

AVIATION/AEROSPACE EDUCATION REVIEW
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Meeting of the
OKLAHOMA STATE REGENTS FOR HIGHER EDUCATION
August 16, 1991

AGENDA ITEM #8-b:

Systemwide Program Review

SUBJECT: Aviation Education

RECOMMENDATION:

It is recommended that the State Regents announce a systemwide external review of all State System aviation-related programs.

STAFF ANALYSIS:

Systemwide program review, as one of the elements of the *Program for Academic Excellence and Efficiency* is designed to strengthen the State System's educational programs and best meet the needs of Oklahoma. Programs targeted for initial reviews include the System's aviation-related programs. The review is timely in light of aviation industry growth and expansion potential and the need to provide appropriate educational services to meet the needs of and to attract the industry to the state.

Over the past several decades, the State Regents have approved aviation programs at a number of colleges and universities. While Oklahoma State University was authorized this last year to take its aviation program (name) to the University Center at Tulsa, no new aviation-related program requests have been approved pending a study of the state's aviation education needs. Several studies and efforts on this matter have been undertaken this past year gathering pieces of information that will be important to State Regents in determining a course of action. The studies have reflected a variety of manpower needs and a number of programs already existing to meet them. To date, no comprehensive study has been undertaken reflecting the comprehensive current and projected statewide needs or reflecting the entire educational spectrum of programs and services in place to meet those needs. While there is little doubt about the expanding aviation education need and demand, it is recommended that a thorough study be undertaken before scarce resources are used to expand services. It is likewise recommended that the State System integrate its educational efforts with those of the vocational-technical system to ensure that state resources can be optimally utilized and that industry needs are addressed.

Program Review Team.

The aviation education program review team will be charged with the task of (1) assessing the status of aviation programs in The Oklahoma State System of Higher Education, (2) evaluating current and projected industry need, and (3) determining optimal delivery of

services that are appropriate responsibilities of the State System and integrative with the vocational-technical education effort.

Specifically, the team will be expected to:

1. Determine the types of aviation education necessary to (a) meet current and future needs of aviation industry already located in Oklahoma and (b) attract and meet needs of new/expanding industry.

2. Assess strengths and weaknesses of the State System's respective aviation education programs.

    a. Evaluate effectiveness of State System aviation education graduates.

    b. Evaluate productivity of respective aviation education programs.

    c. Evaluate specific characteristics of the program's faculty, students, curriculum, facilities, and resources as well as the competence and vitality of the programs' leadership.

3. Assess the role of higher education in the context of programs and services offered by other providers outside the State System, including vo-tech providers, proprietary schools, and industry education programs.

5. Make recommendations on:

    a. Addition, deletion, or modification of State System aviation programs.

    b. Changes related to the continued existence, enhancement, and support of specific aviation education programs.

    c. Industry needs of a collegiate-credit granting nature and the appropriate higher education role in meeting those demands.

    d. Cooperative approaches in the delivery of aviation education services by higher education and vo-tech education.

Collection of Data

Prior to the review team's site visit, a comprehensive set of data will be compiled for the team members' in-depth study. Data will include:

1. A listing of all aviation programs offered at State System institutions

2. Student graduate information for the past five years including:

   a. Geographic origin of graduates

   b. Numbers of students enrolling in each program

   c. Numbers of students graduating from each program

   d. Age, ethnicity, and academic qualification of students in the program

   e. Placement rate and primary employers of graduates

3. Institutional faculty information including:

   a. FTE, rank, tenure

   b. Academic preparation including where college degrees earned

   c. Student/faculty ratio

4. Program resources including:

   a. Instruction, research, and extension budgets

   b. State funds, grants and contracts, private funds

   c. Total revenue per FTE student

   d. Student financial aid

   e. Library Resources

   f. Space and equipment

   g. Staff development funds

   h. Support services

   i. Percent maintenance budget as compared to other academic programs' maintenance budgets.

5. Curricular requirements including:

   a. Respective degree program requirements

b. Currency and diversity of curriculum

c. General education and elective requirements

d. Innovative/experimental/collaborative/apprenticeship programs

6. Inventory of other aviation educational services in Oklahoma, including:

a. Vocational and technical programs

b. Proprietary school programs

c. Industry programs

7. Needs of the aviation industry, including analysis and input from the aviation industry, the State Department of Commerce, and other appropriate groups.

The Program Review Team:

Creditable, knowledgeable, independent team members will be selected from geographic areas generally outside the State of Oklahoma. Possible categories for the selection of members include the aviation industry, a representative of the FAA and/or its Office of Training and Higher Education, a representative of the University Aviation Association, and others. Suggestions for team members have been requested from the Chamber, civic groups, educators, and the industry; and many recommendations have been received.

Team members will receive the compiled data weeks in advance of the on-site visits. The comprehensive review team visits will include conversations with key industry leaders, students, faculty, university administrators, legislators, representatives of vocational-technical education, State Department of Commerce, state and community leaders, etc.

The Time Schedule:

With the acceptance of this program review team charge at the August 16 meeting and authorization to contract with an independent consultant to head the review, the required data will be collected and compiled by staff. A team will be constituted within parameters set out above and notification will be sent to other providers, state and community leaders, and industry representatives of the upcoming study. It is anticipated that the reviews will be completed and the recommendations forthcoming by December 1991.

RECOMMENDED: _____ CONCUR: _____

Future Shortages Expected in the Aviation/Aerospace Industry

Aerospace Industries Association surveys report that industry is anticipating shortages of scientists, engineers and technicians over the next decade to exceed the shortages they experienced in the past. Future shortages are expected in several specialized fields.

Some of the specialty fields are identified as follows:

- Electronic Countermeasures
- Numerical Control Design
- Fiber Optics
- Laser Optics
- Materials Testing
- Spacecraft Integration
- CAD/CAM
- 5 Axis Computerized Manufacturing
- Statistical Process Control
- Fusion Welding
- Industrial Engineering
- Electrical Engineering
- Civil Engineering
- Astro Physics
- Metrology (Standards)
- Meteorology
- Simulation Design
- Airtraffic Control
- Electronics
- Numerical Control Maintenance
- Technical Fabrication
- Chemical Technology
- Computer Technology
- Production Planning
- Robotics
- Sheet Metal
- Composites
- Aeronautical Engineering
- Mechanical Engineering
- Chemical Engineering
- Petroleum Engineering
- Material Engineering
- Test Equipment Maintenance
- Airport Management
- Simulation Maintenance
- Aviation Safety Inspection

Shortages of personnel in manufacturing processes are also expected. Career opportunities will be found in the following areas:

- Receiving
- Procurement
- Fabrication
- Special Processes
- Heat Treatment
- Plating Electrodeposited
- Forming
- Resistance Welding
- Final Assembly & Test
- Preservation, Packaging, Shipping
- Change Control
- Standards (Metrology)
- Quality Assurance Planning
- Cost of Quality
- Training
- Material Stores
- Government Furnished Material
- Assembly
- Inspection Process
- Surface Treatment
- Organic Treatment
- Joining
- Environmental Test Controls
- Nonconforming Material
- Calibration of Equipment
- Evaluation of Measuring Equipment
- Quality Corrective Action
- Supplier Control
- Internal, External Quality Audits
- Certification
- Test Engineering
- Training Equipment Engineering
- Training Simulators
- Weight Engineering
- Wind Tunnel Engineering (Instrumentation)
- Wind Tunnel Engineering (Testing)